MASTER

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MINISTRY OF AGRICULTURE & FISHERIES

NATIONAL AGRICULTURAL ADVISORY SERVICE

SPELLS OF DRY WEATHER IN EASTERN ENGLAND

A REPORT PREPARED BY THE
AGRICULTURAL METEOROLOGY BRANCH
OF THE METEOROLOGICAL OFFICE

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DRY SPELLS IN EASTERN ENGLAND

1. INTRODUCTION

In 1949 a paper entitled "Spells of Dry Weather in South-West England" was published, assessing the liability of that area to dry spells, that is, days on which no more than a trace of rain was recorded. Emphasis was laid on the relative suitability of various months for haymaking.

In 1952 a similar paper was completed for South-East England.

The present paper deals in a similar manner with dry spells in Eastern England. Its main objects therefore are:-

(a) To provide a method of estimating the frequency of spells of dry weather of various lengths for each of the months April to September, with special reference to spells of 3 or more days.

(b) To attempt a numerical estimation of the relative suitability for haymaking of different months in different places.

2. DATA

This investigation covers the counties of Lincolnshire, Huntingdonshire, Cambridgeshire, Norfolk, Suffolk, Bedfordshire, Hertfordshire, and Essex. Figure 1 shows the geographical distribution of the 25 stations used.

3. METHOD

The daily rainfall records from these stations were used to compute the frequencies of 1, 2, 3, etc., consecutive days with no measurable rainfall. Such frequencies are given in Table 1.

In computing the frequencies the following conventions were used:-

(a) A spell of dry weather starting in one month and ending in another was credited to the month with the greater proportion of the spell.

(b) If a spell was equally divided between two months, each of these months was credited with a half spell of the full length.

(c) For spells which began before April 1st., or ended after September 30th., only those days which occurred between April 1st. and September 30th., were included.

4. ESTIMATION OF FREQUENCIES

In "Statistical Methods in Climatology" Brooks and Carruthers considered the frequency of spells of wet weather at Kew, and suggested that after 2, 3, 4, n days of rain, there is a constant probability that it will rain the next day. A similar method has been applied in this investigation.

An examination of the data suggested that after 3, 4, 5, n days the probability that it would be dry the next day would be fairly constant. Therefore for each station, theoretical frequencies for each month were calculated on the assumption of a probability, P, constant for any one month at any one place. The observed and calculated frequencies were compared by a 'chi-squared' test; the resulting differences were seen to be no more than might be reasonably expected from chance fluctuations. As an example of this test the April workings for Cambridge are set out in Appendix I to this paper.

5. METHOD OF PRESENTATION

For each month the frequencies of 1 or more, 2 or more, 3 or more dry days and of P, were plotted on maps and isopleths drawn. Figures 2-13 give the isopleths for 3 or more days and for P for each of the months April to September. The maps for 1 or more and 2 or more dry days are not reproduced but a sufficiently close estimate of these values can be obtained from the data in Table 1.

Figures 2-13 and Table 1 can be used to estimate the frequencies of dry spells of any length, for any place in the area.

TABLE I. - FREQUENCY OF SPELLS OF DRY WEATHER, 1921-46

Length of spells (days)

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	15	TOTAL
LINCOLNSHIRE																	
Guthram																	
April	53	24½	15	7½	6	9½	3	3	1	0	4	1	0	0	0	3	130½
May	53	25½	16	7½	7	5½	11	3	1	1	4	2	1	0	0	2	139½
June	35	21	12	9	12	6	4	1	2	2½	1	1	0	0	1	7	114½
July	48	25½	14	12	6	6	5	0	4	1½	1	5	4	0	1	2	135
August	61	30½	20	11	14	2	4	3	2	4	1	2	2	0	0	0	156½
September	63	39	14	14	4	9	6	2	2	2	1	1	1	1	1	0	160
Boston																	
April	57	26	15	12	8	5	0	4	2	2	0	1	0	1	0	3	136
May	54	27½	6	7	9	6	8	4	1	1	3	3	1	0	0	3	133½
June	41	20½	15	10	9	5	2	2	2	5	2	2	2	0	1	3	121½
July	48	25	16	15	8	4	5	1	4	1	1	2	0	2	1	4	137
August	45	30	10	10	9	5	4	7	3	2	1	0	2	1	0	3	132
September	52	33	21	9	7	5	3	5	3	1	3	1	1	0	0	1	145
Horncastle																	
April	48	23	19	11	7	5½	3	6	0	3	0	1	1	0	0	0	127½
May	56	33	9	9	7	5½	8	2	3	3	0	0	0	1½	0	3	140
June	51	18	16	7	6	7	4	4	2	4	3	0	0	½	1	4	127½
July	41	29	17	11½	7	3	4	1	5	3	1	0	1	0	0	3	126½
August	59	25	16	10½	11	7	5	2	0	4	3	1	0	0	0	0	143½
September	56	31	22	3	4	6	4	5	3	1	2	1	1	0	0	1	140
HUNTINGDONSHIRE																	
St. Ives																	
April	53	25½	17	6	8	3	4	5	1	3	2	1	0	1	0	2	131½
May	46	23½	17	17½	8	5	7	3	0	2	3	2	2	1	0	2	139
June	43	17	8	17½	10	5	4	3	2	4	0	4	0	0	0	4	121½
July	54	26	16	12½	10	4	4	5	6	0	1	1	3	0	0	1½	144
August	48	34	14	9½	10	6	4	2	3	2	1	0	2	1	0	3½	140
September	64	26	16	9	4	8	3	7	1	2	1	0	0	1	0	4	146
NORTHANTS																	
Peterborough																	
April	49	29½	16	6½	8	5	3	2	2	2	2	1	0	1	0	2	129
May	45	27	14	10	10	5	6	4	1	0	2	2	2	0	0	3	131
June	38	25	8	11½	10	8	1	3	0	2	2	1½	0	2	1	5	118
July	49	20	17	17½	5	1	6	2	4	2	4	2½	1	0	1	1	133
August	63	26½	20	14½	11	9	1	1	2	3	0	0	1	1	0	1	154
September	50	26	21	6	9	6	4	2	1	3	2	0	2	1	0	2	135
CAMBS. and ELY																	
Cambridge																	
April	37	32	14	9	10	5	3	2	2	2	3	0	1	0	1	2	123
May	52	13½	13	17½	10	6	7	3	2	1	3	1	3	0	0	2	134
June	41	16½	13	13½	12	4	0	2	0	2	4	3	1	1	0	6	119
July	49	29	14	11½	4	1	3	1	4	2	3	1	3	1	0	3	129½
August	53	29½	12	12	5	8	5	2	2	0	3	0	1	1	1	3	137½
September	52	28½	16	11½	6	6	1	4	1	1	3	1	1	1	2	2	137
Stretham																	
April	49	24	17	8	8	8	4	3	3	2	3	2	0	1	1	2	135
May	41	22	12	15½	13	5	7	3	2	4	1	3	2	0	0	3	133½
June	42	12½	7	14½	8	8	5	2	2	2	2	2	0	0	2	6	115
July	48	28½	18	6½	4	5	4	2	5	2	1	2	2	0	1	4	133
August	58	31	14	11½	6	5	9	4	1	2½	2	0	1	0	1	4	150
September	46	31	17	9	8	9	1	2	1	1½	2	1	3	2	0	3	136½

TABLE I (Contd.)

Length of spells (days)

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	15	TOTAL
CAMBS. and ELY (Contd.)																	
Wisbech																	
April	56	30	16	11½	7	7	3	2	3	1	2	1	0	0	0	2	141½
May	49	22	11	12½	9	6	5	6	2	1	3	0	2	1	0	1	132½
June	44	16	14	10½	9	4	7	2	2	0	1	2	0	1	2	6	120½
July	61	22	15	12	7	5	3	1½	3	2	3	0	0	1	1	2	138½
August	65	36	18	14½	8	3	4	4½	1	4	1	0	1	0	1	2	143
September	59	32	19	6	6	9	5	5	0	2	2	0	0	0	1	1	147
NORFOLK																	
Thetford																	
April	55	31	12	7½	7	6	4	4	1	3	1	1	0	0	0	1	133½
May	43	26	15	14½	10	3	4	4	1	1	2	1	1	0	1	1	127½
June	39	14	13	10	10	7	2	0	1	2½	2	3	2	1	1	3	110½
July	56	24	19	12	7	2	3	2½	2	1½	2	1	1	1	1	1	136
August	57	32	15	12	5	4	6	2½	2	5	0	0	0	0	1	1	142½
September	72	29	15	8	4	3	2	3	2	0	2	3	1	0	1	0	145
Hunstanton																	
April	58	19½	28	6½	6	5½	3	3	4	0	3	1	0	1	0	1	139½
May	46	35½	7	9½	7	6½	10	5	2	1	1	0	2	1	0	1	134½
June	41	22½	10	12	8	12	1	1	1	3	4	2½	1	1	0	3	123
July	54	26½	16	8	9	9	2	3	2	1	1	1½	0	0	2	4	139
August	48	28	16	10	9	5	5	3½	3	4	2	0	2	1	0	1	137½
September	49	30	18	4	7	9	5	5½	3	1	1	0	2	0	0	2	136½
Wiggenhall																	
April	47	23½	18	13	8	5½	2	3	2	4½	1	1	0	1	0	2	131½
May	45	29	15	9	7	10½	5	2	1	2½	4	1	1	1	1	1	135
June	40	19½	10	11	9	5½	6	0	1	2	7	3	1	0	0	4	119
July	53	21	17	12	8	6½	5	1	1	1	1	1	1	0	1	4	133½
August	54	26	23	10	7	6	5	3	1	2	1	0	2	0	1	2½	143½
September	54	28	16	11	7	12	6	1	1	0	2	0	1	0	2	1½	142½
Norwich (Sprowston)																	
April	44	24	13	14	7	2	5	3½	1	2	1	2	0	0	0	1	119½
May	35	18	17	8½	11	6	5	5½	0	0	3	2	2	0	0	2	115
June	40	18	14	8½	9	5	3	4	2	1	5	1	1	1	1	2	115½
July	51	21	19	10½	6	3	2	8	2	1	2	2	2	1	1	1	132½
August	63	21	11	14½	7	8	5	2½	2	2	1	2	1	0	1	1	142
September	57	27	16	11	2	8	3	2½	1	3	0	0	0	0	0	2	132½
Cromer																	
April	58	30	20	11	6	5½	6	4	1	2	0	1	0	0	0	1	145½
May	42	32½	17	7	12	7½	3	2	1	0	2	1	2	0	1	1	131
June	31	21½	17	8	6	10	3	1	3	3	5	5	2	0	0	0	115½
July	50	27	21	11	5	6	3	5	2	0	0	0	0	2	1	2	135
August	56	31	17	9	6	6	5	2	2	2	0	1	0	0	1	1	139
September	59	32	13	10	5	5	6	0	1	1	2	0	0	1	0	1	136
SUFFOLK																	
Lowestoft																	
April	58	25	12	11	9	4	5	2½	3	0	2	1	0	0	0	1	133½
May	39	23½	13	9½	12	5	4	1½	4	1	2	2	2	0	1	3	122½
June	41	25½	12	6	5	2½	5	4	3	5	4	5	1	1	0	1	121
July	56	29	11	8	7	3½	5	5	2	1	4	0	4	0	0	2	137½
August	50	21	19	15½	5	6	3	2	0	3	4	2	0	1	1	1	133½
September	46	27	18	13	5	8	3	4	2	0	1	1	1	0	0	2	131

TABLE I (Contd.)

Length of spells (days)

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	15	TOTAL
SUFFOLK (Contd.)																	
Bury St. Edmunds																	
April	45	23½	13	11	7	8	4	3½	4	1	2	1	1	0	0	1	125
May	44	20	16	13½	11	6	1	4½	2	1	4	3	0	0	0	3	129
June	29	12½	11	10½	11	2	3	1	2	3	6	3	0	1	0	4	99
July	43	26½	6	12½	7	6	3	0	3	2	2	2	0	2	1	3	119
August	56	30½	16	17	10	3	3	2	2	1	2	1	0	1	2	3	149½
September	62	27	17	9½	3	6	1	3	2	0	2	1	5	0	0	1	139½
Campsea Ashe																	
April	53	21½	15	15	11	6	4	3	2	2	1	2	0	1	0	1	137½
May	41	24½	8	11½	10	5	6	5	2	2	1	2	1	0	0	4	123
June	43	14	13	6	6	7½	8	2	4	2	1	2	0	1	1	8	118½
July	50	33	16	9	2	6½	3	3½	1	3	2	2	2	0	0	4	137
August	53	23	14	14½	9	3	7	3½	3	2	4	2	1	1	0	2	142
September	54	35	20	6	10	5	3	1	2	1	2	3	2	0	1	1	146
Hadleigh																	
April	49	26	10	6	11	5	4	3	5	0	2	2	0	0	0	1	124
May	45	16	11	14	11	5	6	2	2	2	0	1	2	0	0	5	122
June	47	19	13	5½	12	4	5	0	1	1	4	1	2	0	2	5	121½
July	53	22	19	8	4	3	8	3½	2	4	1	0	0	1	0	4	132½
August	51	26	17	16½	6	8	5	3½	1	1	1	1	1	1	1	2	142
September	75	26	21	3	6	2	4	1	2	2	1	1	1	2	0	2	149
BEDFORDSHIRE																	
Woburn																	
April	54	30½	12	7	6	2	3	3	2	1	2	0	0	1	0	3	126½
May	51	20½	17	11	9	7	6	3	1	2	1	1	1	0	0	0	130½
June	40	23	11	10	10	4	4	1	1	4	1	2	1	0	1	4	117
July	53	31½	15	10½	6	2	3	3½	5	2	2	0	2	0	1	0	136½
August	54	26½	13	11	5	4	2	6½	1	1	1	1	1	1	0	2	130
September	66	31	17	7½	8	7	3	3	1	3	0	0	0	0	0	1	147½
Bedford																	
April	46	27	15	8	7	2	1	1½	4	5	2	0	0	1	0	3	122½
May	49	20	20	10½	9	7	6	3½	0	0	3	2	1	1	0	2	134
June	40	21	10	7½	10	5	4	4½	1	2	0	2	1	0	1	7	116
July	46	25	17	8	12	3	3	4	4	1	2	4	2	0	0	1	132
August	48	30	16	13½	5	3	3	6½	2	2	1	1	1	1	1	2	136
September	56	26	12	8½	11	5	5	2	1	1	2	1	0	1	0	3	134½
HERTFORDSHIRE																	
Rothamsted																	
April	54	24	14	3	10	3	5	2	0	3	2	0	0	1	0	4	125
May	60	17	14	4	12	7	7	3	0	0	2	3	1	0	0	1	131
June	45	18	8	10	7	7	6	2	1	1	2	4	0	1	1	5	118
July	70	30½	14	8½	4	3	5	1	3	2½	2	0	2	0	0	2	147½
August	58	29½	15	9½	6	3	5	5	4	1½	2	1	1	1	0	2	143½
September	73	34	14	8	6	1	6	1	0	3	1	0	0	1	0	2	150
Therfield																	
April	53	26	14	11	6	4	2	5	0	2	2	0	0	0	1	3	129
May	59	18	15	10	12	10	4	1	0	3	1	2	0	0	0	2	137
June	46	13	7	9½	12	4	4	3	0	3	1	3	3	1	0	5	114½
July	65	26	16	13	6	4	5	2	4	1	2	1	0	0	0	2½	147½
August	63	24	18	10½	10	4	3	2	3	1	2	1	1	1	0	1½	145
September	54	36	16	12	5	5	1	4	2	1	2	0	0	3	0	1	142

TABLE I (Contd.)

Length of spells (days)

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	15	TOTAL
ESSEX																	
Bradwell Bay																	
April	54	26	11	7	11	2	8	5	4	1	1	0	0	0	0	6	136
May	33	21	18	9½	13	2	6	3	2	3	2	3	2	1	1	4	123½
June	37	19	14	7½	13	5	3	2	2	2½	1	1	0	1	1	9	118
July	44	24½	18	8	6	4	5	3	6	3½	4	2	2	0	0	4	134
August	49	22½	19	16	4	3	5	5	4	1	3	2	1	1	0	5	140½
September	47	29	15	14	4	5	4	3	5	1	2	0	0	3	0	3	135
Ingatestone																	
April	45	23	8	11½	2	7½	3	7	3	1	0	1	0	2	0	2	116
May	52	23	15	10	12	2½	5	0	4	3	0	2	0	1	0	3	132½
June	42	21	15	12½	9	4	1	3	0	3	3	1	1	1	2	5	123½
July	50	23	21	8	7	5	5	1	2	1	5	2	1	0	0	3	134
August	62	27	19	11	5	10	0	4	4	1	3	1	1	1	1	1	151
September	69	28	22	7	5	3	1	5	3	4	1	0	1	1	1	0	151
Halstead																	
April	50	26	13	6	8	3	5	4	4	3	5	0	0	1	1	1	130
May	41	26	11	11	14	3	3	4	1	2	3	2	3	2	0	1	127
June	45	21	9	10	11	6	4	3	2	0	0	4	0	0	0	9	124
July	43	20½	18	7	8	6	4	0	3	4	1	1	3	1	0	4	123½
August	49	29	16	11	5	7	4	5	4	2	1	1	1	3	0	3	141
September	68	25½	20	7	6	5	1	1	6	1	2	2	2	1	1	1	149½
Hatfield																	
April	46	22½	11	6	9	5	6	3	1	2	3	1	1	1	0	1	118½
May	45	15½	14	11½	10	6	4	3	3	4	1	1	1	1	0	4	124
June	39	17	9	10½	11	5	1	2	1	3	1	2	2	0	1	7	111½
July	52	27	17	8	4	3	3	4	1	2	5	0	3	0	0	2½	131½
August	50	26½	15	4½	9	6	5	4	6	1	1	0	2	2	0	1½	133½
September	56	32½	20	7½	8	3	1	3	2	3	1	1	1	1	0	1	141

6. AVERAGE LENGTH OF SPELLS OF DRY WEATHER

Table II gives the following information:-

(a) average length of dry spells
(b) average length of dry spells lasting at least 3 days
(c) average length of dry spells lasting at least 7 days

The chief features of the monthly distribution of the average length of spells lasting at least 3 days are as follows:-

TABLE II

AVERAGE LENGTH OF SPELLS OF DRY WEATHER: (a) 1 day; (b) 3 days; (c) 7 days

	APRIL			MAY			JUNE		
	(a)	(b)	(c)	(a)	(b)	(c)	(a)	(b)	(c)
LINCS.									
Guthram	3.4	6.5	12.0	3.5	6.3	9.5	4.3	7.1	12.7
Boston	3.2	6.1	12.3	3.7	7.3	10.5	4.0	6.7	11.4
Horncastle	3.0	5.2	8.9	3.2	6.5	9.8	3.8	6.7	10.8
HUNTS.									
St. Ives	3.4	6.4	10.9	3.7	6.0	10.3	4.0	6.6	11.0
NORTHANTS									
Peterborough	3.3	6.3	11.5	3.6	6.3	10.6	4.1	7.1	12.7
CAMBS. and ELY.									
Cambridge	3.6	6.2	11.2	3.7	6.2	10.3	4.3	7.1	13.6
Stretham	3.7	6.5	11.0	4.0	6.5	10.5	4.5	7.4	12.2
Wisbech	3.1	5.9	11.1	3.6	6.2	9.9	4.1	7.0	11.7

TABLE II (Contd.)

AVERAGE LENGTH OF SPELLS OF DRY WEATHER: (a) 1 day; (b) 3 days; (c) 7 days

	APRIL			MAY			JUNE		
	(a)	(b)	(c)	(a)	(b)	(c)	(a)	(b)	(c)
NORFOLK									
Thetford	3.0	6.1	10.1	3.4	5.7	10.3	4.1	6.7	12.2
Hunstanton	3.2	5.5	10.6	3.4	6.4	9.0	3.9	6.7	11.9
Wiggenhall	3.4	5.8	10.7	3.6	6.3	10.6	4.2	7.1	11.3
Norwich (Sprowston)	3.3	5.8	10.1	3.9	6.0	10.1	3.9	6.5	10.6
Cromer	2.9	5.2	8.9	3.3	5.7	10.7	4.1	6.3	10.3
SUFFOLK									
Lowestoft	3.0	5.8	10.1	4.1	6.9	11.9	4.0	7.2	10.0
Bury St. Edmunds	3.4	5.9	9.7	3.7	6.1	11.1	4.6	7.1	11.5
Campsea Ashe	3.3	5.8	10.5	3.9	6.8	10.5	4.6	7.7	11.5
Hadleigh	3.3	6.4	10.2	3.9	6.6	11.3	4.0	7.3	12.3
BEDFORD									
Woburn	3.1	6.7	11.7	3.1	5.3	8.7	3.9	6.9	11.8
Bedford	3.6	6.9	12.5	3.5	5.9	10.5	4.3	7.6	12.4
HERTS.									
Rothamsted	3.4	6.9	11.9	3.2	6.1	9.8	4.3	7.7	12.2
Therfield	3.3	6.4	12.0	3.2	5.7	10.6	4.2	7.4	11.5
ESSEX									
Bradwell Bay	3.6	6.9	10.4	4.4	6.8	11.3	4.5	7.4	13.1
Ingatestone	3.6	6.9	10.8	3.4	6.2	11.1	4.1	6.9	12.8
Halstead	3.5	6.6	9.8	3.8	6.6	11.0	4.3	7.7	13.2
Hatfield	3.4	6.3	9.6	4.0	6.6	11.1	4.5	7.8	14.0
		JULY			AUGUST			SEPTEMBER	
	(a)	(b)	(c)	(a)	(b)	(c)	(a)	(b)	(c)
LINCS.									
Guthram	3.8	6.7	10.9	3.1	5.5	9.5	3.0	5.7	9.5
Boston	3.7	6.3	11.1	3.8	6.9	10.7	3.1	5.6	9.6
Horncastle	3.5	6.1	10.7	3.0	5.4	9.1	3.0	5.7	9.3
HUNTS.									
St. Ives	3.4	6.0	9.8	3.5	6.5	11.3	3.2	6.2	10.4
NORTHANTS									
Peterborough	3.6	6.0	9.9	2.9	5.2	10.7	3.3	5.8	10.4
CAMBS. and ELY									
Cambridge	3.5	6.8	11.2	3.5	6.8	12.1	3.4	6.3	11.5
Stretham	3.8	7.1	11.9	3.5	6.7	10.5	3.6	6.4	12.2
Wisbech	3.2	6.0	10.7	3.3	5.7	10.0	3.0	5.8	9.9
NORFOLK									
Thetford	3.1	5.7	10.4	3.0	5.7	9.2	2.7	5.8	10.1
Hunstanton	3.4	6.3	11.6	3.5	6.0	9.7	3.3	6.0	9.5
Wiggenhall	3.4	6.1	11.6	3.3	5.8	10.7	3.2	5.8	10.3
Norwich (Sprowston)	3.5	6.1	10.2	3.2	6.0	9.8	2.8	5.5	10.1
Cromer	3.2	5.6	10.5	2.9	5.5	9.6	2.8	5.6	10.0
SUFFOLK									
Lowestoft	3.4	6.8	10.2	3.4	5.8	10.6	3.3	5.7	10.9
Bury St. Edmunds	3.7	7.0	11.6	3.4	6.1	11.8	3.0	6.0	10.9
Campsea Ashe	3.6	6.9	11.7	3.6	6.3	10.0	3.2	6.0	11.2
Hadleigh	3.5	6.4	10.3	3.4	5.8	10.3	2.8	6.0	10.7
BEDFORD									
Woburn	3.1	5.9	9.6	3.2	6.2	10.5	2.8	5.6	11.0
Bedford	3.5	6.1	10.0	3.4	6.2	10.4	3.3	6.4	11.4
HERTS.									
Rothamsted	2.9	6.2	10.1	3.3	6.3	9.9	2.7	6.1	10.9
Therfield	3.0	5.9	10.2	3.1	5.8	10.7	3.1	6.0	11.4
ESSEX									
Bradwell Bay	4.0	6.9	10.5	4.0	6.8	11.5	3.6	6.5	11.0
Ingatestone	3.5	6.1	10.7	3.2	5.9	10.7	2.8	5.6	9.8
Halstead	4.0	6.7	11.8	3.7	6.6	10.7	3.1	6.1	10.9
Hatfield	3.4	6.6	11.0	3.6	6.5	10.1	3.0	5.8	11.0

APRIL The spells are less than 7 days long and as low as 5.2 days at Cromer and Horncastle and 5.5 days at Hunstanton. Lincs, Norfolk and Suffolk usually have spells averaging less than 6 days while the southern counties of Essex, Herts. and Beds. average over 6.5 days while the central eastern counties of Cambs., Hunts. and Northants. have the intermediate value of 6 to 6.5 days.

MAY The only spell lasting over 7 days occurs at Boston (7.3 days) with Lowestoft (6.9 days) and Campsea Ashe and Bradwell Bay (6.8 days) next in length. The shortest spells occur at Woburn (5.3 days), and Thetford, Cromer, Therfield (5.7 days).

JUNE The longer spells occur in the more southern counties of Suffolk, Essex and Herts, which average over 7 days with the longest spell (7.8 days) at Hatfield.

The shorter spells occur in the more northern counties of Norfolk and Lincs, which average below 7 days, the shortest spells occurring at Cromer (6.3 days) and Sprowston (6.5 days).

JULY All spells are between 5.9 and 6.9 days with the exception of Stretham (7.1 days), Bury St. Edmunds (7.0 days) and Cromer (5.6 days), Thetford (5.7 days).

AUGUST All spells are between 5.7 and 6.7 days with the exception of Boston (6.9 days), Cambridge, Bradwell Bay (6.8 days) and Peterborough (5.2 days), Horncastle (5.4 days), Guthram, Cromer (5.5 days).

SEPTEMBER All spells are between 5.6 and 6.4 days with the exception of Bradwell Bay (6.5 days) and Sprowston (5.5 days).

The features of the average length of SPELLS LASTING AT LEAST 7 DAYS are as follows:-

APRIL The shorter spells occur in Norfolk, Suffolk, and Essex where the length is between 9.6 and 10.8 days at all stations except Cromer (8.9 days). In these Counties the longest spells are 10.8 days at Ingatestone, 10.7 days at Wiggenhall and 10.6 at Hunstanton.

The longest spells occur in Lincs, Beds. and Herts. where the length is between 11.7 and 12.5 with the one exception of Horncastle (8.9 days). The longest spells were at Bedford (12.5 days) and Boston (12.3 days).

The remaining areas have the following intermediate values:-

St. Ives (10.9), Stretham (11.0), Wisbech (11.1), Cambridge (11.2), Peterborough (11.5).

MAY The longer spells occur in Suffolk and Essex, where the lengths are between 11.0 and 11.3 days except Lowestoft (11.9 days) and Campsea Ashe (10.5 days).

All the remaining stations have spells between 9.8 days (Horncastle, Rothamsted) and 10.7 days (Cromer) with the exception of Woburn (8.7 days), Hunstanton (9.0 days) and Guthram (9.5 days).

JUNE The longest spells occur in the SE. of the area, at Hatfield (14.0 days), Cambridge (13.6 days), Halstead (13.2 days), Bradwell Bay (13.1 days) and Ingatestone (12.8 days).

The shortest spells occur in the NE. at Lowestoft (10.0 days), Cromer (10.3 days), Sprowston (10.6 days), Horncastle (10.8 days).

All other stations have spells between 11.0 days (St. Ives) and 12.7 days (Guthram, Peterborough).

JULY The longest spells occur in the four eastern counties at Stretham (11.9 days), Halstead (11.8 days), Campsea Ashe (11.7 days) and Hunstanton, Wiggenhall, Bury St. Edmunds (11.6 days).

The shortest spells (9.6-10.2 days) occur in the four western counties of Herts, Beds, Hunts, Northants, though Lowestoft and Sprowston have 10.2 days.

At remaining stations spells vary from 10.3 days (Hadleigh) to 11.2 days (Cambridge).

AUGUST The longest spells occur at places in the central or more southern part of the area at Cambridge (12.1 days), Bury St. Edmunds (11.8 days), Bradwell Bay (11.5 days) and St. Ives (11.3 days).

The shortest spells occur at places in the north and northeast of the area at Horncastle (9.1 days), Thetford (9.2 days), Guthram (9.5 days), Cromer (9.6 days) Hunstanton (9.7 days), Sprowston (9.8 days).

At remaining stations the spells vary from 9.9 days (Rothamsted) to 10.7 days (Boston, Peterborough, Wiggenhall, Therfield, Ingatestone, Halstead).

SEPTEMBER The longest spells occur in the central western area at Stretham (12.2 days), Cambridge (11.5 days), Bedford and Therfield (11.4 days).

The shortest spells occur in Lincs. (9.3 - 9.6) and at Hunstanton (9.5 days), Ingatestone (9.8 days) and Wisbech (9.9 days), all in the north of the area, except the last.

At remaining stations the spells vary from 10.0 days (Cromer) to 11.2 days (Campsea Ashe). These include all the stations in Norfolk (except Hunstanton), Suffolk and Essex (except Ingatestone), the three eastern counties.

7. CHANCES OF A SPELL OF 3 OR MORE, 6 OR MORE, 12 OR MORE, AND 15 OR MORE DRY DAYS IN ANY ONE YEAR.

Table I giving the frequency of spells within the 26 year period, still gives no precise indication of their distribution. Table III has therefore been constructed to show the number of years when there was at least one spell of the above lengths. In the compilation the same conventions were used as in Table I except that:-

(a) If a spell is equally divided between two months, each month is credited with half a spell of that length and a whole spell of ½ length, e.g. if a spell comprised of 9 days in May and 9 days in June is observed, then each month is credited with one half spell of 18 days or more and also with a whole spell of 12 days or more.

(b) When a dry spell starts in one month and ends in another, the month with the shorter number of days is credited with a spell of length equal to those days. Even though the full spell is credited to the month with the greater number of days, it is obviously untrue to say that the other month did not have a spell of the shorter length.

Table III can be used to estimate the chances of a given spell in any one year.

For example, at Peterborough there were 13 years out of 26 when there was at least one dry spell of 9 days or more in July; we may thus say that there is an even chance of such a spell in any one particular year.

Reviewing the table as a whole we see that the chances of at least one spell of three days or more with no rain during each of the months from April to September are high at all stations - at least 12 to 1 on, with the one exception of Lowestoft in April, which is over 7 to 1 on. Halstead (Essex) has experienced such a spell in each of the months every year of the reviewed period.

For at least one spell of 6 or more days, there is at least an even chance at all places and at all times. At Campsea Ashe (Suffolk) in May, the chance of a dry spell of 6 or more days is as high as 12 to 1 on.

For at least one spell of 9 or more days, the chances in September fall, on the average, to over 2 to 1 against, and actually to over 4 to 1 against at Wiggenhall and Woburn. April is next with a chance on the average of nearly 2 to 1 against, being over 4 to 1 against at Horncastle and as low as 11 to 2 against at Cromer, which was the worst observation as far as 9 day spells were concerned. June is the best month on the average for 9 day spells, varying from an even chance to 19 to 7 on at Lowestoft.

TABLE III

	Length of dry spells (days)						*Length of dry spells (days)*				
	⩾3	⩾6	⩾9	⩾12	⩾15		⩾3	⩾6	⩾9	⩾12	⩾15
LINCOLNSHIRE						**CAMBS & ELY**					
Guthram						Wisbech					
April	26	18½	9	4	3	April	26	15	8	3	2
May	25	22	11	4	2	May	25	21	11	4	1
June	26	20	13	9	8	June	26	21	14	10	8
July	26	20	14	9	3	July	24	19	11	4	3
August	26	13	10	4	0	August	26	16	10	4	3
September	25	18	8	4	1	September	26	19	6	2	2
Boston						**NORFOLK**					
April	25	15	9	5	3						
May	25	22	12	7	3	Thetford					
June	26	21	14	8	4	April	24	15	7	2	1
July	26	19	12	8	4	May	25	19	9	4	2
August	25	18	10	4	2	June	26	20	15	9	4
September	26	18	9	3	1	July	24	16	9	5	2
						August	24	17	9	2	2
Horncastle						September	24	13	7	4	1
April	25	16½	5	2	0						
May	24	20	9	3½	3	Hunstanton					
June	26	22	14	5½	5	April	25	14½	9	3	1
July	26	15	11	3	2	May	26	23	8	4	1
August	25	16	7	1	0	June	26	23	15	7½	3
September	25	18	8	3	1	July	26	18	10	6½	5
HUNTINGDONSHIRE						August	26	18	11	4	1
						September	26	22	6	4	2
St. Ives						Wiggenhall					
April	26	17	10	4	2	April	26	16½	10½	4	2
May	25	20	12	7	2	May	26	22½	12½	4	2
June	26	20	15	8	4	June	26	22	16	7	4
July	26	18	11	6	2	July	26	17	8	6	5
August	25	16	10	6	3	August	24	17	10	6	4
September	26	20	9	5	4	September	26	20	5	4	3
NORTHANTS						Norwich (Sprowston)					
						April	26	15	7	3	1
Peterborough						May	25	20	10	6	2
April	25	17	9	4	2	June	26	18	13	6	3
May	26	21	11	7	3	July	26	17	11	6	2
June	26	21	14	9½	6	August	25	21	10	5	2
July	26	17	13	4½	2	September	25	16	6	2	2
August	25	14	9	3	1						
September	26	19	9	5	2	Cromer					
						April	26	15½	4	2	1
CAMBS. & ELY						May	26	19	8	5	2
						June	26	21	16	7	0
Cambridge						July	26	18	5	4	2
April	26	17	11	4	3	August	25	17	6	3	2
May	26	23	12	6	2	September	25	13	6	2	1
June	26	20	15	10	6						
July	26	18	14	8	3						
August	25	20	11	6	4	**SUFFOLK**					
September	26	16	10	7	4						
						Lowestoft					
Stretham						April	23	16	7	2	1
April	26	21	13	6	3	May	25	21	15	8	4
May	25	22	14	7	3	June	26	23	19	8	1
June	26	22	15	10	8	July	26	18	12	5	2
July	26	22	15	9	5	August	26	20	11	5	2
August	26	20	12½	6	5	September	26	17	7	4	2
September	26	20	12½	9	3						

TABLE III (Contd.)

	Length of dry spells (days)						Length of dry spells (days)				
	≥3	≥6	≥9	≥12	≥15		≥3	≥6	≥9	≥12	≥15
SUFFOLK						**ESSEX**					
Bury St Edmunds						Bradwell Bay					
April	26	19	9	3	1	April	26	20	10	6	6
May	25	22	14	6	3	May	26	21	18	10	5
June	26	21	17	8	4	June	26	20	15	12	10
July	25	18	13	8	4	July	26	22	17	7	3
August	26	17	12	7	5	August	25	21	15	7	4
September	25	17	10	6	1	September	26	18	14	6	3
Campsea Ashe						Ingatestone					
April	26	18	9	4	1	April	26	19½	9	5	2
May	25	24	13	7	4	May	26	18½	14	6	3
June	26	23	16	12	9	June	26	20	16	10	7
July	26	22	14	8	4	July	26	21	14	6	3
August	26	19	12	6	2	August	26	18	10	4	2
September	26	17	10	6	2	September	25	15	10	3	1
Hadleigh						Halstead					
April	26	17	10	3	1	April	26	19	12	3	2
May	25	21	13	8	5	May	26	20	13	8	1
June	26	22	16	9	6	June	26	22	15	12	9
July	26	20	12	4	3	July	26	20	14	8	3
August	26	21	9	6	3	August	26	20	13	7	3
September	26	15	10	6	2	September	26	17	12	6	2
BEDFORDSHIRE						Hatfield					
						April	25	19	9	4	1
Woburn						May	26	21	14	7	4
April	25	15	9	4	3	June	26	21	17	11	8
May	25	20	7	2	0	July	26	19	12	5	2
June	25	19	13	8	5	August	25	19	11	5	2
July	25	16	10	3	1	September	25	13	8	3	1
August	25	17	8	5	2						
September	24	14	5	1	1						
Bedford											
April	26	16	14	4	3						
May	26	22	10	6	2						
June	25	21	14	11	8						
July	25	18	12	7	1						
August	25	19	10	5	2						
September	26	16	9	5	3						
HERTFORDSHIRE											
Rothamsted											
April	24	16	9	5	4						
May	26	19	8	5	1						
June	26	21	15	10	6						
July	26	17	10½	4	2						
August	25	18	10½	4	2						
September	26	14	7	3	2						
Therfield											
April	24	16	8	4	4						
May	25	20	9	4	2						
June	25	22	15	12	5						
July	26	16	10	4	3						
August	25	16	11	5	2						
September	25	13	9	4	1						

For spells of 12 days or more, June is the most favourable month (though at some stations it shares first place with July) but the highest chance recorded was only 14 to 12 against at Campsea Ashe, Therfield, Bradwell Bay and Halstead (in June) all in the south or southeast of the area. The lowest chance in June was nearly 4 to 1 against at Horncastle and 10 to 3 against at Sprowston in the north and northeast of the area. On the other hand, the chances are as low as 12 to 1 against or even lower at several places in each of the months April and September with only 2 places in August and one in May, only the months of June and July not recording such odds.

The chances of at least one spell of 15 or more days vary considerably from about two years out of five at Bradwell Bay in June to none at all. No such spells were reported by Guthram (August), Horncastle (April, August), Cromer (June), Woburn (May).

8. HAYMAKING

A comparison of the suitability of various months in Eastern England

To compare the suitability of the months April to September the method applied was that used for southwest and southeast England. An index was devised which combines the effect of both the frequency and length of the dry spells. Indices were compared by two methods of assessment:-

(a) A value of 3 is given to a spell of 3 days, 4 to 4 days, etc., the sum of such values being the index for the month.

(b) A value of 1 is given to a spell of 3 days, and a value of 2 to a spell of 4, on the assumption that two spells of 3 days can be used for haymaking in a dry spell of 4 days. Similarly a spell of 5 days is given a value of 3, etc. The total is again used as the monthly index.

It was found that no great difference existed in the magnitudes of the two sets of indices, and in the following discussion those obtained by the method (a) will be used.

The monthly indices for both methods are given in Table IV.

From this table we may deduce:-

(i) Judging by the criterion of dry spell indices (a) and (b), June, (with a total of 10337) is the best month at every station in the area with the exception of Boston in July and St. Ives, Stretham, Lowestoft and Bradwell Bay in May.

(ii) Over the area as a whole the second, third and fourth best months are respectively:- May (9519), August (9109), July (9085), which are very similar. The worst months April (8195) and September (7989) are also very close.

9. COMPARISON WITH OTHER PARTS OF ENGLAND

From the previous papers on dry spells for southwest and southeast England the following indices are quoted:-

	May	June	July	August	
Newquay	300	345	204	252	SW. worst record
Weymouth	344	493	348	374	SW. best record
Selborne	366	400	289	338	SE. worst record
Worthing	427	471	374	402	SE. best record

Comparable figures for the same period for eastern England are as follows:-

	May	June	July	August	
Woburn	313	371	306	305	E. worst record
Bradwell Bay	473	461	449	469	E. best record

Comparing the two sets of figures we see that Bradwell Bay, the best station in respect of dry spells in eastern England is also the best in all the three areas, except for June where the best station is Weymouth (SW) and the next best is Worthing (SE). As far as the worst record of each area is concerned, the order of the areas is (i) southwest (ii) east (iii) southeast for each of the months May, June and August but for July the order is southwest, southeast, east.

10. LONG DRY SPELLS

In a previous paper on southwest England, attention was concentrated on the chances of obtaining a sufficiently long dry period to perform the necessary operations for haymaking without the expensive modern aids of grass drying. As experience and statistics show us, such chances are higher in eastern England and the problem, as in the case of southeast England is not so urgent. In fact, the problem of drought is probably the more important. Therefore the following dry weather index was calculated to compare the variations from time to time and place to place of long dry spells:-

TABLE IV - SPELLS OF DRY WEATHER - SUITABILITY INDICES

	APRIL		MAY		JUNE		JULY		AUGUST		SEPTEMBER	
	(a)	(b)	(a)	(b)	(a)	(b)	(a)	(b)	(a)	(b)	(a)	(b)
LINCS.												
Guthram	342	236	383	261	415	298	412	289	357	227	333	217
Boston	323	217	380	276	400	280	406	278	392	278	336	216
Horncastle	293	180	332	230	392	275	343	230	323	204	302	196
HUNTS.												
St. Ives	304	234	418	279	404	281	383	255	375	259	349	237
NORTHANTS												
Peterborough	316	215	374	256	390	280	384	256	334	205	345	227
CAMBS. & ELY												
Cambridge	337	229	422	285	435	312	350	247	375	265	356	243
Stretham	402	278	455	314	447	326	404	291	406	284	383	264
Wisbech	326	215	383	260	421	300	335	224	355	231	323	211
NORFOLK												
Thetford	289	194	335	218	384	269	318	206	303	196	257	169
Hunstanton	343	219	341	235	398	279	371	254	371	248	344	229
Wiggenhall	356	234	386	264	423	304	363	244	368	241	349	228
Norwich (Sprowston)	299	196	373	249	374	259	372	251	346	230	266	169
Cromer	301	186	323	210	400	274	325	209	288	184	254	164
SUFFOLK												
Lowestoft	295	194	411	291	391	282	355	250	361	236	331	215
Bury St. Edmunds	335	222	399	269	406	291	348	249	384	258	304	203
Campsea Ashe	364	238	391	276	471	348	373	265	418	286	343	229
Hadleigh	312	214	401	279	404	293	368	253	375	245	288	192
BEDFORD												
Woburn	282	198	313	195	371	263	306	202	305	206	284	183
Bedford	342	243	384	254	418	308	372	250	359	243	338	233
HERTS.												
Rothamsted	324	230	327	219	422	312	290	196	354	242	283	177
Therfield	320	220	343	223	408	297	332	219	336	220	310	206
ESSEX												
Bradwell Bay	388	276	473	334	461	337	449	318	469	331	381	263
Ingatestone	331	235	359	244	420	299	375	253	368	244	304	196
Halstead	356	248	395	275	449	333	405	285	416	290	344	232
Hatfield	315	215	418	291	433	322	346	241	371	257	302	197

A value of 7 was given to a spell of 7 days, 8 to 8 days, etc. and the monthly totals were entered in Table V.

Figures 14-19 show the isopleths of frequencies of dry spells of 7 or more days.

Considering the totals, for the six months April to September, added for each station, we note that the regions most likely to suffer from long dry spells are:-

(a) North Essex and the southeast corner of Suffolk.
(b) The south of Cambridgeshire.

The areas which are likely to suffer least are:-

(a) Cromer on the northeast Norfolk coast.
(b) Thetford area of Norfolk.
(c) Woburn area of Essex.
(d) Horncastle area of Lincolnshire.

The months most likely to suffer from dry spells are:-

June (index total 6446) with July (5400) and May (5267) occupying second and third place.

The months least likely to suffer from dry spells are:-

September (4173) with April (4514) and August (4963) occupying second and third places.

TABLE V - DRY WEATHER INDEX

	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER
LINCS.						
Guthram	180	237	247	256	171	161
Boston	160	253	240	234	247	172
Horncastle	124	201	244	193	136	168
HUNTS.						
St. Ives	207	227	230	211	209	197
NORTHANTS.						
Peterborough	172	212	222	232	107	177
CAMBS. & ELY						
Cambridge	179	227	258	236	218	196
Stretham	231	262	280	274	258	202
Wisbech	155	207	268	177	185	158
NORFOLK						
Thetford	152	164	213	166	161	142
Hunstanton	170	208	208	192	208	185
Wiggenhall	177	207	271	185	188	150
Norwich (Sprowston)	157	197	223	225	172	116
Cromer	134	139	227	157	135	120
SUFFOLK						
Lowestoft	146	244	291	234	181	152
Bury St. Edmunds	169	206	264	209	200	164
Campsea Ashe	168	241	333	240	255	179
Hadleigh	173	227	259	241	180	171
BEDFORD						
Woburn	176	131	224	177	173	121
Bedford	218	195	278	211	214	183
HERTS.						
Rothamsted	202	167	281	176	223	153
Therfield	180	138	265	178	166	159
ESSEX						
Bradwell Bay	260	304	294	309	310	230
Ingatestone	206	199	256	215	182	167
Halstead	235	230	291	247	257	196
Hatfield	183	244	279	225	227	154

APPENDIX I

As an example, the method of extracting the value of P for Cambridge in the month of April is given below:-

Frequency of dry spells at Cambridge in April

(1) Length of dry spell (days)	(2) Observed Frequency (O)		(3) Observed Cumulative Frequency	(4) Computed Cumulative Frequency	(5) Computed Frequency (C)		(6) $\frac{(O-C)^2}{C}$
1	37						
2	32						
3	14		54	54.0	12.7		0.13
4	9		40	41.3	9.7		0.05
5	10		31	31.6	7.5		0.83
6	5		21	24.1	5.7		0.09
7	3		16	18.4	4.3		
8	2	7.0	13	14.1	3.3	10.2	1.00
9	2		11	10.8	2.6		
10	2		9	8.2	1.9		
11	3		7	6.3		8.2	0.78
12	0		4				
13	1	9.0	4		6.3		
14	0		3				
15	1		3				
16 or more	2		13*				

*13 is the value of the cumulative frequencies for 16, 17, 18, ... etc. days. It is needed to obtain the total of 229, used in the calculation of P.

Given N spells of 3 or more days, the assumption of a constant probability P implies that the theoretical frequency of spells of 3 or more, 4 or more, 5 or more, days, etc., is given by the successive terms of the series:-

$$N\,(1 + P + P^2 + P^3 + \ldots\ldots\ldots\ldots)$$

The sum of this series is T, the sum of the cumulative frequencies from 3 or more days onwards.

Therefore, $T = N/(1-P)$

hence, $P = I - N/T$

Using the observed figures T is 229, and N is 54, hence P is 0.7642.

In the above table, columns 2 and 3 are the observed values. Column 4 is constructed by use of the observed value of 54 and the calculated P; successive substraction of the figures in column 4 gives the computed frequencies in column 5, which are to be compared with the observed frequencies in column 2.

This comparison is done by a "chi-squared" test; the value for this parameter is the sum of the figures in column 6, that is 2.88.

With four degrees of freedom, the probability of obtaining a greater value for this and hence greater deviations, purely due to chance, from the actual frequencies lies between 0.70 and 0.80; there is thus no reason to reject the hypothesis of constant probability.

Agricultural Meteorology Branch,

Meteorological Office.

January, 1953.

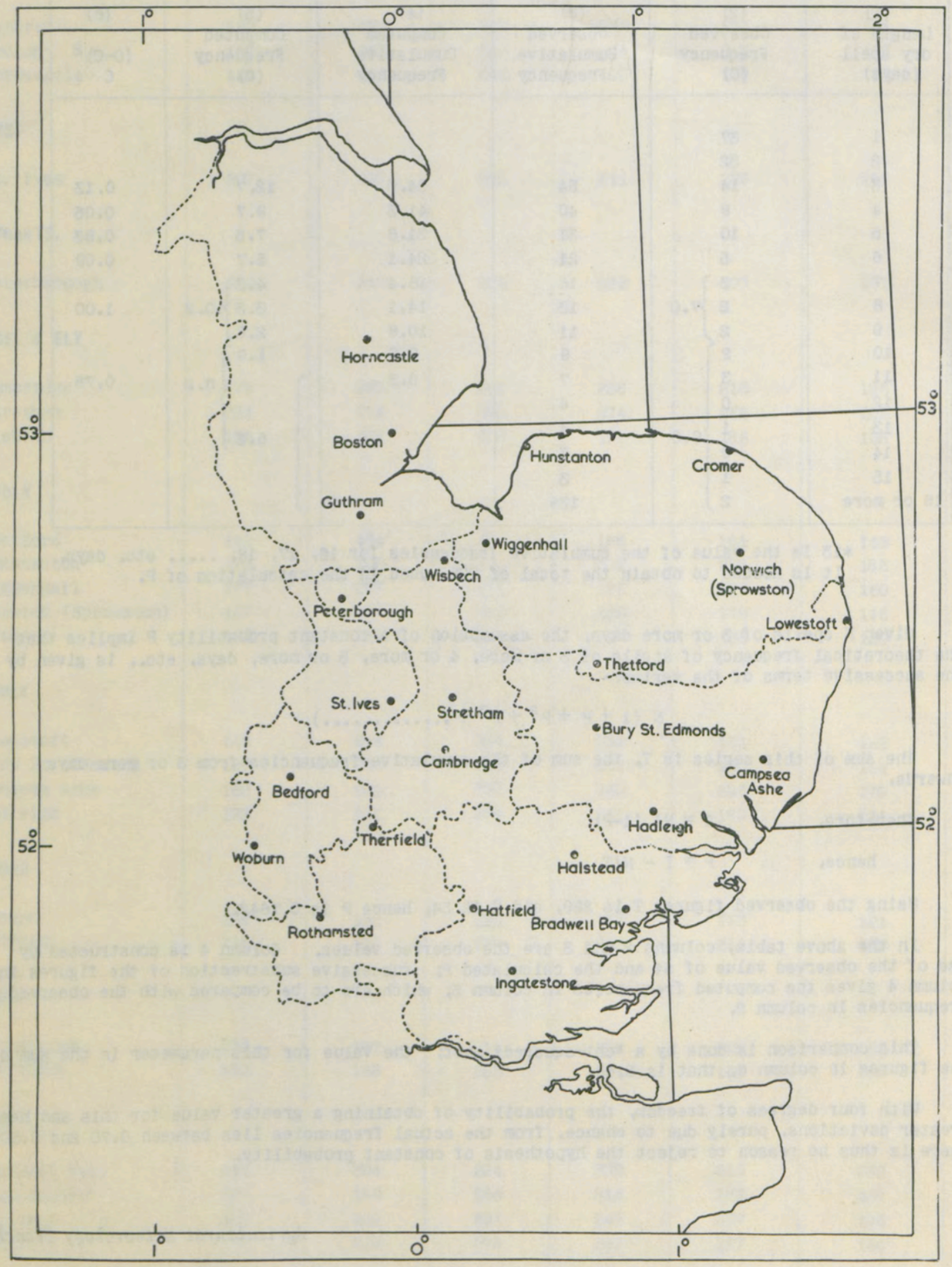

FIG. 1 — INDEX MAP OF STATIONS

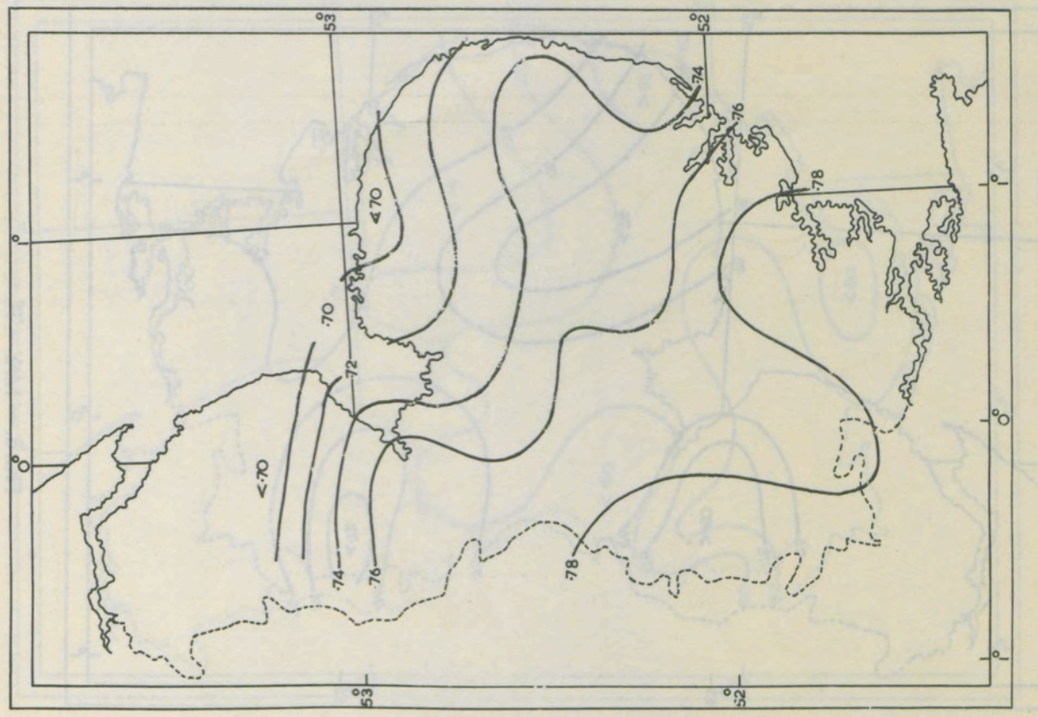

FIG. 3.– APRIL— 'P'

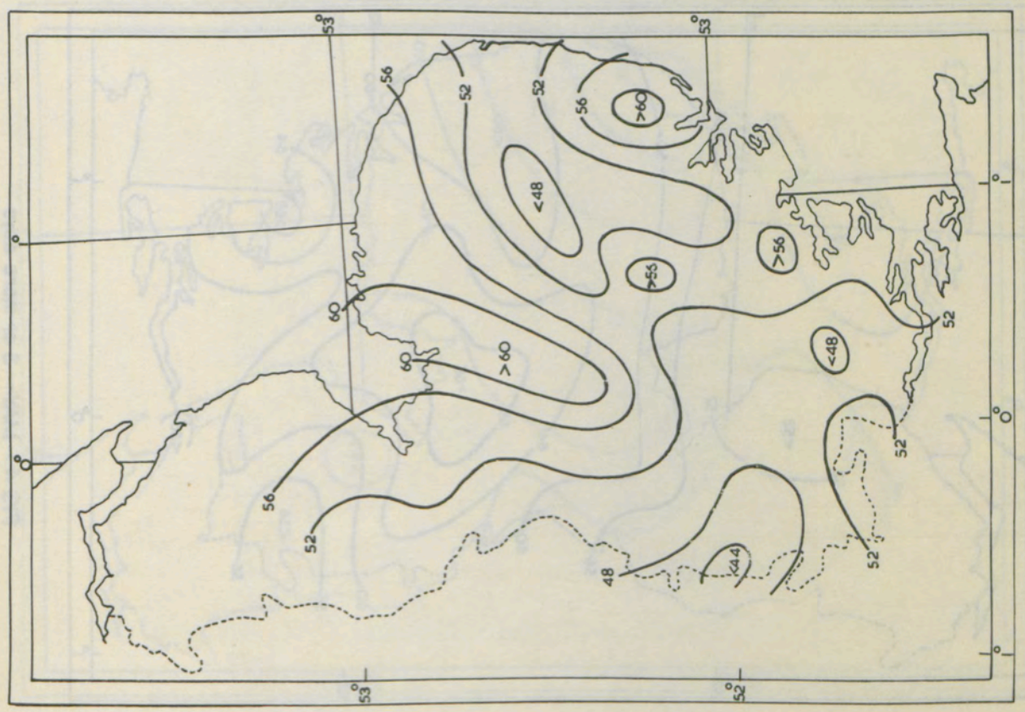

FIG.2.–APRIL— 3 or more days

DS 46767/1

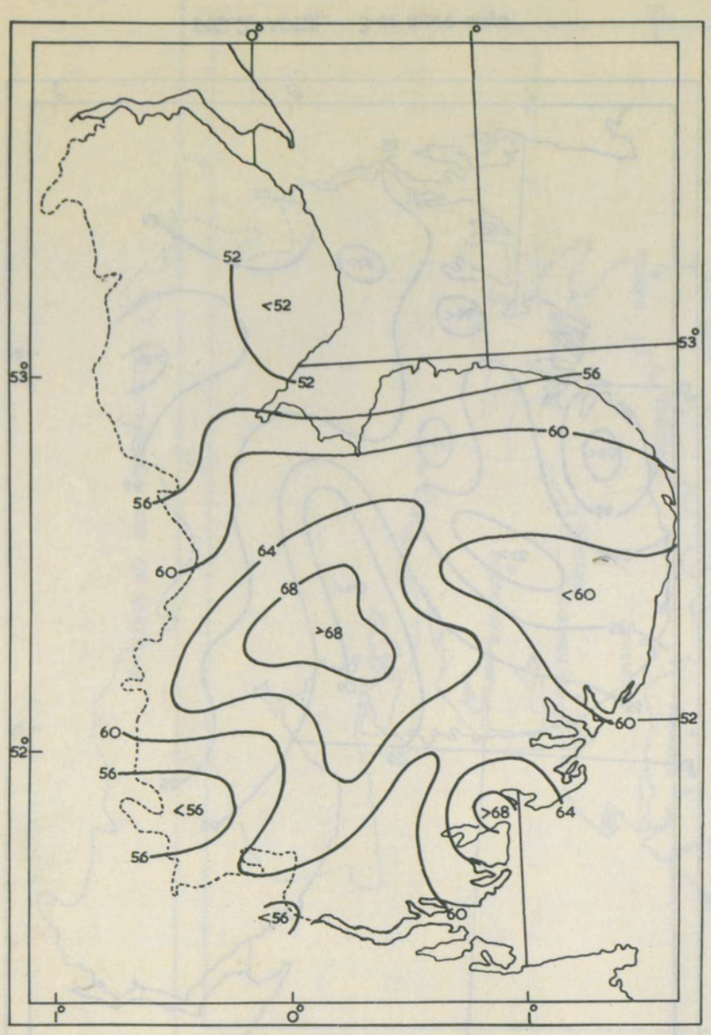

FIG 4.– MAY— 3 or more days

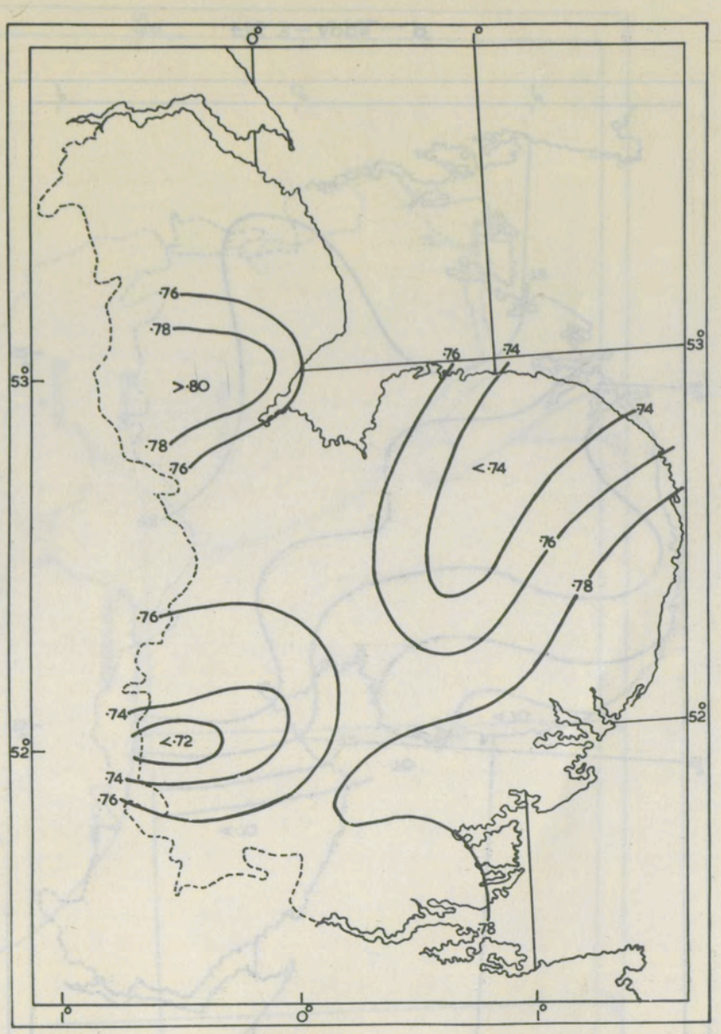

FIG. 5. — MAY — 'P'

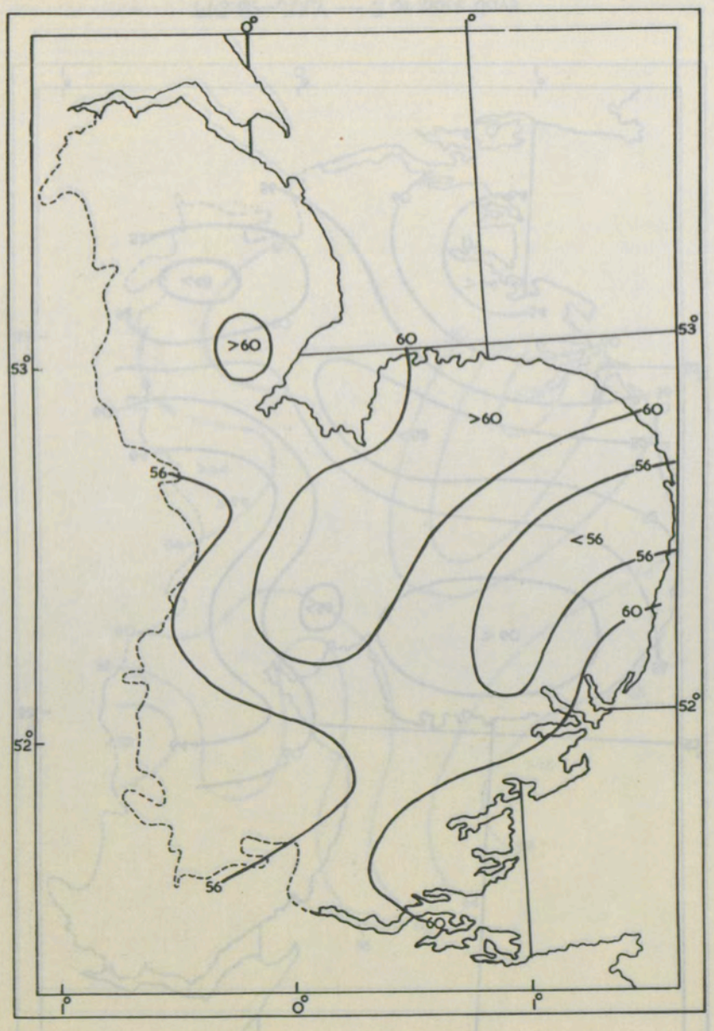

FIG. 6.–JUNE— 3 or more days

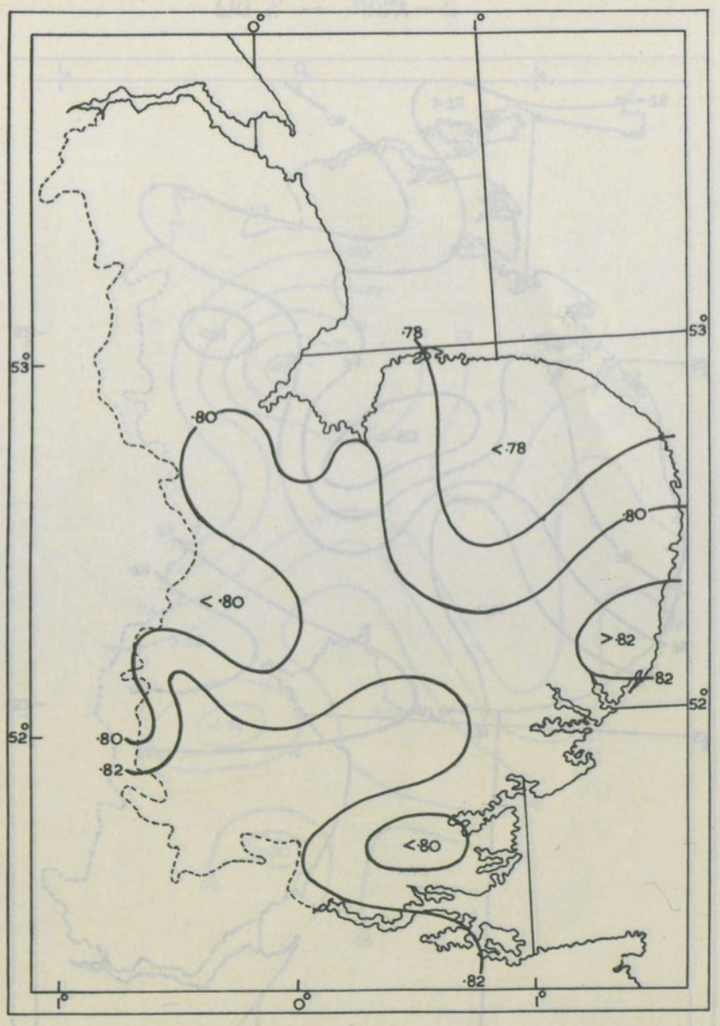

FIG. 7. — JUNE — 'P'

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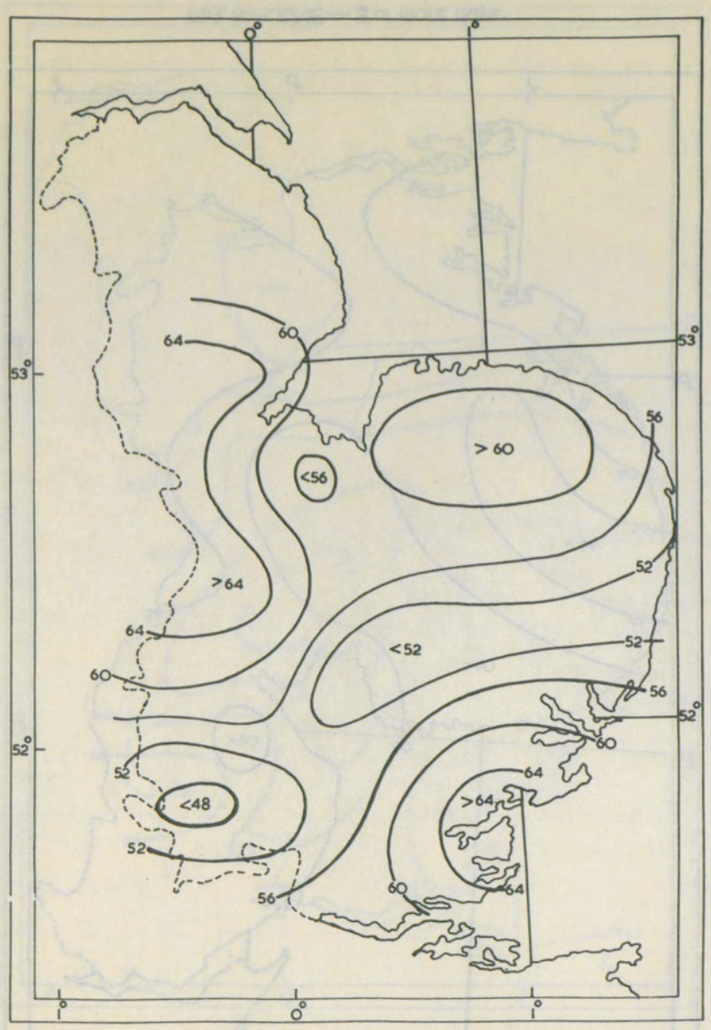

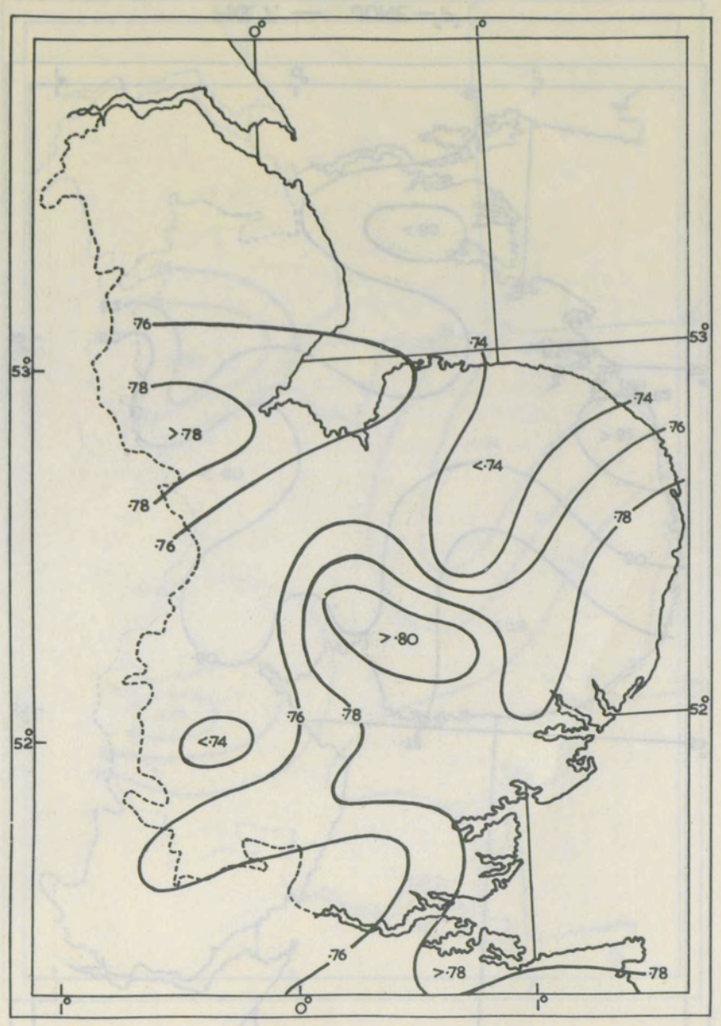

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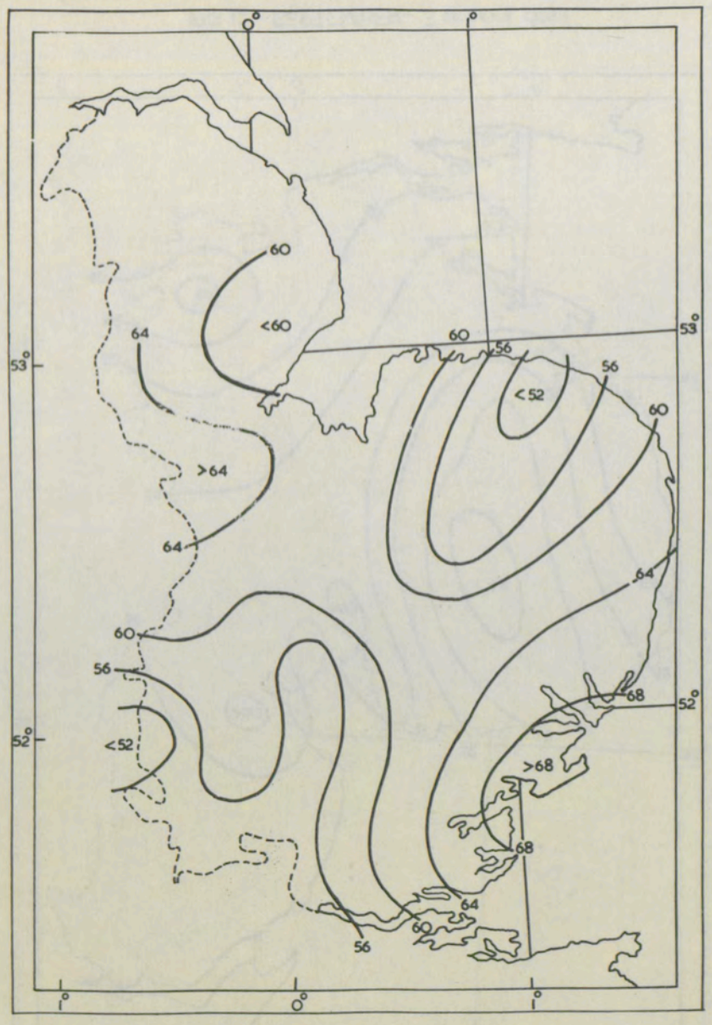

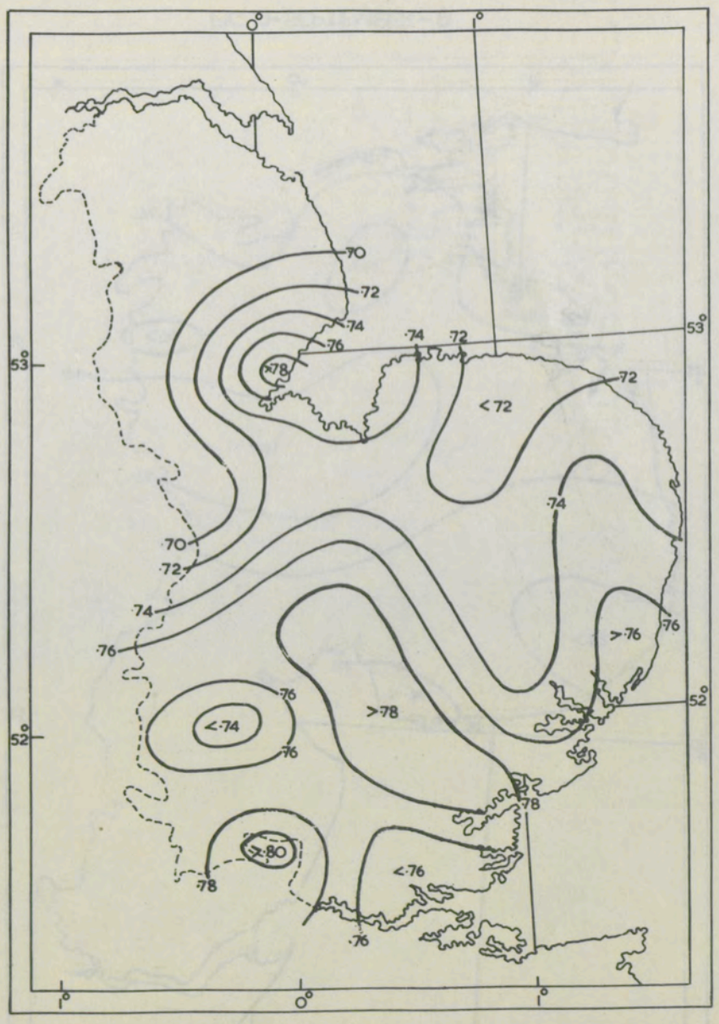

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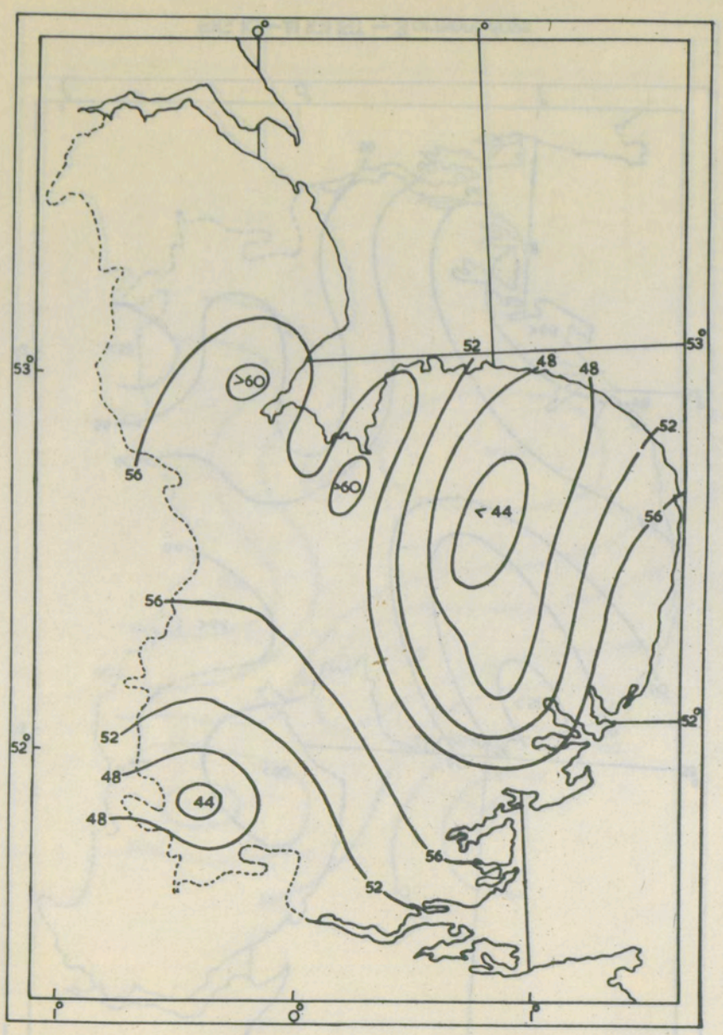

FIG.12.—SEPTEMBER—3 or more days

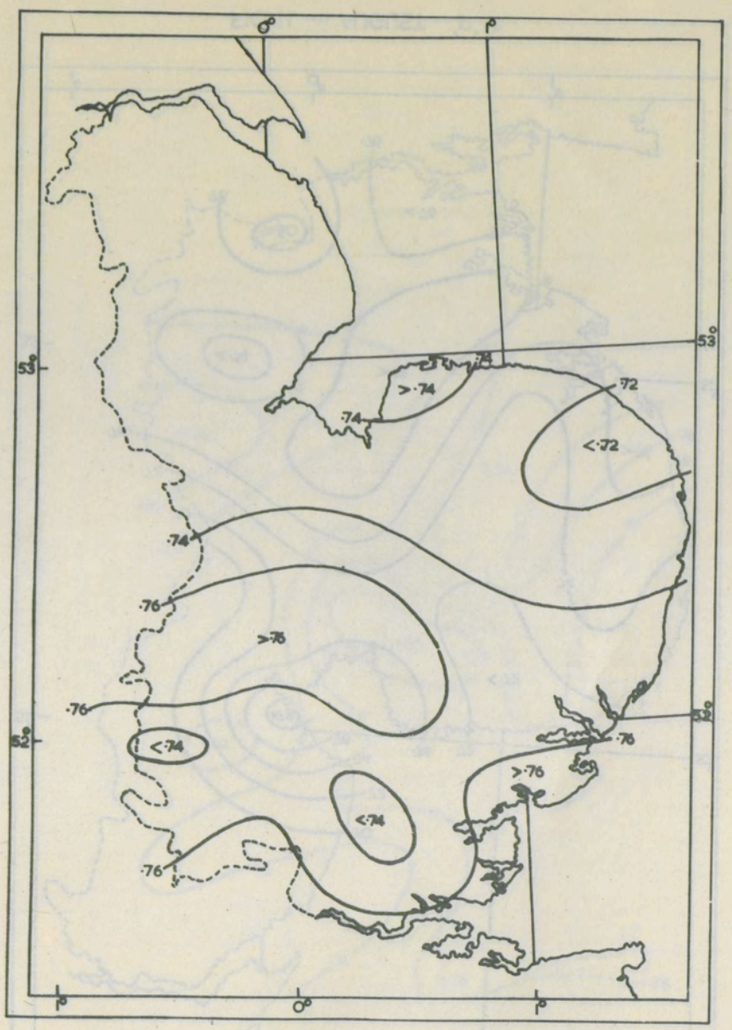

FIG.13.-SEPTEMBER—'P'